

VIII. MULTIPATH TRANSMISSION

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A. TRANSATLANTIC FM STUDY

Processing and analysis of the data obtained during the recent field test have been completed. Results of this test, together with a resumé of earlier field tests, are being written and will be published as Technical Report No. 278.

In addition, we have made a half-hour tape recording that summarizes, and gives examples of, reception in the recent test.

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B. NARROW-BAND LIMITING

The calculations of the minimum requirements in limiter and discriminator bandwidths for FM interference rejection (reported in the Quarterly Progress Reports of September 15, 1953, and January 15, 1954) have been checked and extended. The results are reproduced here in graphical form.

Figure VIII-1 shows the final plot of the minimum limiter bandwidth (in terms of an ideal bandpass filter following an ideal limiter) required for the stronger of two signals (of relative magnitudes 1 and $a < 1$) to capture. This plot differs from the plot of Fig. IX-1, p. 35, Quarterly Progress Report of January 15, 1954, by showing in finer detail the behavior of the curve in the range $0.863 < a < 0.907$. The nature of the ideal limiter filter is such that the variation in the minimum requirement takes place in discrete steps throughout.

Figure VIII-2 shows the final extended and checked plots of minimum requirements in frequency detector bandwidth vs limiter bandwidth. These curves differ from the curves expected on the basis of the few points plotted in Fig. IX-2, p. 35, Quarterly Progress Report, January 15, 1954. Again, the nature of the ideal bandpass filter after the limiter is responsible for the broken-line character of these curves. (The ideal filter has constant gain and linear phase shift with frequency over its passband, and vertical skirts at the cutoff points.)

The plots of Fig. VIII-2 bring out two important facts. First, the minimum requirement in discriminator bandwidth is always less than, but approaches asymptotically, the values specified in Technical Report 42. A little thought shows this to be perfectly plausible, for as the limiter bandwidth becomes very large essentially all of the side-band components are passed, and the resultant signal at the output of the limiter filter approaches the amplitude-limited value of the resultant of the two signals delivered by the intermediate-frequency section to the ideal limiter. Since the ideal limiter action per se does not affect the instantaneous variations in the frequency of the signal, the values specified by the equation

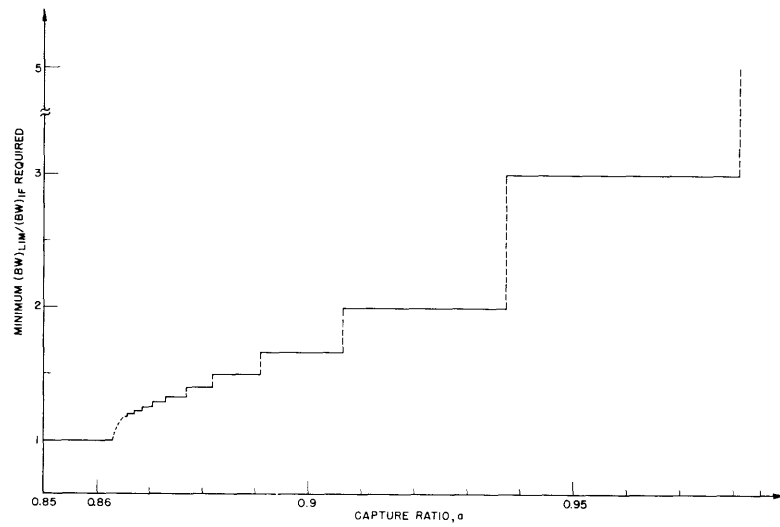


Fig. VIII-1

Variation of the minimum limiter bandwidth requirements with the desired capture ratio.

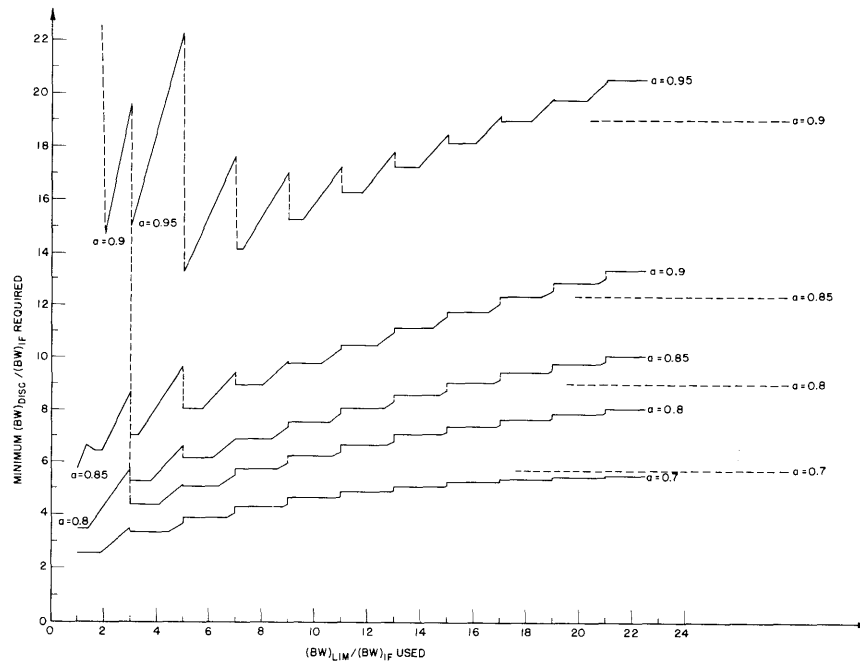


Fig. VIII-2

Variation of the minimum discriminator bandwidth requirements with the limiter bandwidth used for various capture ratios, a .

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$$\frac{(BW)_{disc.}}{(BW)_{if}} = \frac{1 + a}{1 - a}$$

(see Technical Report No. 42) become the limiting values approached as the limiter bandwidth becomes very large. The plotted, calculated curves bring this out very clearly. The asymptotic values are indicated by the dotted horizontal lines superimposed upon the curves.

The second observation brought to light by the plots of Fig. VIII-2 is that cascading alternate stages of limiting and filtering should in fact reduce the requirements in discriminator bandwidth to smaller and smaller values. The curves are plotted for only one stage of limiting and filtering, but the results are indicative of what would happen with further cascaded stages. Clearly, if it were possible to do without a limiter stage (as when an amplitude-insensitive discriminator is used) the requirements in discriminator bandwidth would be dictated by the equation quoted above, namely, the asymptotic values in the plots of Fig. VIII-2. The reduction in requirements achieved by the action of the first stage of limiting and filtering upon the resultant signal delivered to it by the intermediate-frequency section would conceivably be duplicated (though possibly to a varying degree) by the action of the second limiting-filtering stage upon the signal delivered to it, in turn, by the first stage, and so on.

Thus, in addition to eliminating interference coming in as amplitude variations, a limiter-filter stage is seen to be effective in relaxing the requirements on the frequency detector to achieve rejection of FM interfering signals that may approach the desired signal in strength.

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